



⑪ Publication number : **0 480 445 B1**

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EUROPEAN PATENT SPECIFICATION

④⑤ Date of publication of patent specification :
03.05.95 Bulletin 95/18

⑤① Int. Cl.⁶ : **F26B 21/04, F26B 23/02**

②① Application number : **91117360.7**

②② Date of filing : **11.10.91**

⑤④ **System for drying green woods.**

③⑩ Priority : **12.10.90 JP 272187/90**

④③ Date of publication of application :
15.04.92 Bulletin 92/16

④⑤ Publication of the grant of the patent :
03.05.95 Bulletin 95/18

⑥④ Designated Contracting States :
DE FR GB IT SE

⑤⑥ References cited :
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FR-A- 544 959

⑤⑥ References cited :
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Description

The invention relates to a method for drying wood and to a system for carrying out this method.

In particular the invention is concerned with drying green woods, green bamboos and like green plants (which have been harvested) to produce, in short periods of time, dried woods, dried bamboos and like dried plants having been stabilized in water content.

After harvest, green woods (and the like) are still rich in water content, and usually carry a plenty of insects and their eggs. Consequently, in producing lumbers for building use and/or furniture use, it is usual to dry the green woods and chemically treat the same to kill the insects and their eggs.

In drying process, the green woods are hitherto subjected to natural seasoning in which it is necessary to leave the green woods as they are for a long period of time, for example such as three to five years in a wood yard. During this long period of time, it is necessary for workers of the wood yard to frequently move the woods to enhance the drying process thereof. However, leaving the woods for such long period of time in the wood yard results in a poor investment, and is further disadvantageous in preventing the woods from insect attacks.

Under such circumstances, hitherto, various quick drying processes for drying the woods in short periods of time have been proposed. For example, one of these conventional drying processes is of a vacuum drying type. Another of these conventional drying processes is of a thermal heating type using a drying room to which a hot air is supplied.

However, the dried woods produced through the conventional quick drying processes are disadvantageous in preventing the woods from: cracking; and absorbing moisture causing distortion of the woods, as is in the dried woods produced through the natural seasoning.

In order to solve the above problems inherent in the conventional quick drying processes, the another conventional process (i.e., conventional thermal heating type process) has been proposed. In the conventional thermal heating type process, green woods are first housed in a drying room in which is directly introduced a hot combustion gas produced by burning waste woods and the like, so that the green woods are brought into contact with the hot combustion gas so as to be dried and disinfected with heat and various smoke elements of the combustion gas to kill insects and their eggs in the woods, without: being subjected to any chemical treatment; and causing any distortion of the dried woods.

For example, Japanese Patent Laid-Open Nos. Sho 59-129373 and 60-103281 disclose one of the above conventional thermal heating type process in which: green woods are housed in a treatment cham-

ber which has: its upper area subjected to a hot blast; and its lower area subjected to a cool blast, so as to drying the woods. These Japanese Patent Laid-Open documents also disclose a system for carrying out the process which is, however, poor in treatment efficiency of the woods. In the process, in case that a plenty of green woods are housed in the treatment chamber in order to improve the treatment efficiency, the dried woods obtained through the process tend to vary in water content, which makes it impossible to stabilize the products (or dried woods) in quality.

FR-A-544959 already discloses an apparatus for drying wood comprising a drying room having a row of blowers at a sealing thereof and a separate room comprising a generator for drying air including a blower, an air inlet for introducing fresh air and a conduit connecting it with the drying room. The air inlet and the connecting conduit comprise control slides, and there is an exhaust-gas discharging conduit extending from the drying room.

However, this preknown system is disadvantageous due to poor treatment efficiency of the woods owing to the oxygen content of the used combustion gas and the air pollution caused since vapor and volatile materials are not burnt before the gas is discharged from the system.

In view of the above problems adherent in the conventional drying processes and systems, the present invention was made, and it is the object of the invention to provide a method and a system to produce high quality products or dried woods with good yields without contaminating the atmosphere by volatile gases produced from the green woods during drying operation. However, a low oxygen content and an even stabilized temperature distribution is required to obtain dried woods with stabilized water content with a good quality, which have no cracks.

According to the invention, this object is obtained by the method according to claim 1 and a system according to claim 2. Further embodiments are contained in subclaims 3 to 9.

In the system of the present invention, it is also possible to connect the combustion-gas recovery conduit with the air-inlet conduit.

Further, in the system of the present invention, the gas flow-rate control unit (which is provided in at least one of the exhaust-gas discharging conduit and the combustion-gas recovery conduit) is preferably constructed of, in combination, a fan and a damper. In addition, it is also possible that the gas flow-rate control unit is constructed of only one of the fan and the damper.

Furthermore, it is also preferable to provide a fan and/or a damper in the air-inlet conduit of the system of the present invention. However, the provision of the air-inlet conduit is not indispensable to the system of the present invention.

In the system of the present invention, however,

it is preferable to provide a fan in at least one of the air-inlet conduit, exhaust-gas discharging conduit and the combustion-gas recovery conduit.

In operation of the system of the present invention having the above construction for drying the green woods and the like, waste woods and the like are burned in the combustion-gas generator of the system to produce a hot combustion gas accompanied with smoke. Then, the hot combustion gas is introduced into an upper area of the wood drying room through the combustion-gas supplying passage.

In the wood drying room, the hot combustion gas passes through the green woods (which are piled up in the room) downward to heat and dry the same, and reaches a bottom area of the room, from which bottom area the combustion gas flows into the exhaust-gas discharging conduit and is discharged to the atmosphere through the chimney of the system.

In the above operation of the system of the present invention, a part of the combustion gas flowing out of the bottom area of the wood drying room is so circulated as to enter the combustion-gas recovery conduit through which the thus circulated part of the combustion gas is returned to the combustion-gas generator in which the thus circulated part of the combustion gas is used to control a combustion speed of the fuel (i.e., waste woods) in the generator in cooperation with a fresh air introduced into the generator through the air-inlet conduit.

In an efficient drying operation of the green woods in the wood drying system of the present invention, it is necessary for the system to produce a combustion gas with substantially no oxygen content. In addition, it is not desirable for a temperature of the combustion gas to excessively increase. Therefore, the circulation of the combustion gas in part is desirable in the system of the present invention. By circulating a part of the combustion gas through the system of the present invention, it is possible for the system to recover vapor and volatile materials from the combustion gas before the gas is discharged from the system through the chimney. The thus recovered volatile materials are subjected to combustion again and burned in the system before they are discharged to the atmosphere through the chimney, which combustion contributes towards the solution of air pollution (caused by the volatile materials contained in the combustion gas) and also contributes to cost saving since the volatile materials may be utilized as fuels in the system of the present invention.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows a longitudinal sectional view of the wood drying system of the present invention, illustrating the construction of the system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinbelow, the present invention will be described in detail with reference to the accompanying drawing.

As shown in the drawing, in drying operation of green woods (and the like), the woods are housed and piled up in a wood drying room 1. The room 1 is capable of being sealed, while so disposed as to be adjacent to a combustion-gas generator 2 an upper area of which is communicated with an upper area of the wood drying room 1 by means of a combustion-gas supplying passage 3.

A lower area of the combustion-gas generator 2 forms a combustion chamber 21 in which suitable fuels such as waste woods and the like are burned to produce a hot combustion gas. With the combustion chamber 21 of the combustion-gas generator 2 is connected an air-inlet conduit 4 for introducing a fresh air into the combustion chamber 21.

Rotatably mounted in an opening-end portion of the air-inlet conduit 4 is a damper 41 for control a flow rate of fresh air introduced into the combustion chamber 21 of the combustion-gas generator 2.

At a plurality of bottom or floor positions of the wood drying room 1, the room 1 are connected with a plurality of combustion-gas recovery conduits 5 connected with the air-inlet conduit 4.

Mounted in each of the combustion-gas recovery conduits 5 are: a fan 51 for sucking the combustion gas from the wood drying room 1 to supply the same gas to the combustion-gas generator 2; and a damper 52 for control a flow rate of the thus sucked combustion gas from the wood drying room 1.

On the other hand, an exhaust-gas discharging conduit 6 is so connected with a corner portion of the wood drying room 1 as to be oppositely disposed from the combustion-gas supplying passage 3 in a diagonal direction of the wood drying room 1, whereby an inlet portion of the exhaust-gas discharging conduit 6 is positioned at the remotest point of the wood drying room 1 as to the combustion-gas supplying passage 3. The exhaust-gas discharging conduit 6 extends to a chimney 7 from which an exhaust gas passing through the conduit 6 is discharged into the atmosphere.

In the exhaust-gas discharging conduit is rotatably mounted a damper 61 for controlling a flow rate of the exhaust gas to be discharged into the chimney 7.

In operation of the wood drying system of the present invention having the above construction, first, a suitable carrier such as a bogie carries green woods to the wood drying room 1 in which the green woods are piled up on the floor of the room 1. After that, the room 1 is so closed as to be hermetically sealed, and then a suitable fuel such as waste woods

and the like are burned in the combustion chamber 21 of the combustion-gas generator 2 to produce a hot combustion gas which flows out of the generator 2 into the wood drying room 1 through the combustion-gas supplying passage 3.

At this time, when the damper 61 of the exhaust-gas discharging conduit 6 is closed, the hot combustion gas is gradually filled in the wood drying room 1 to replace an air previously confined in the room 1, which air is sucked into the combustion chamber 21 of the combustion-gas generator 2 through the combustion-gas recovery conduits 5. Until the room 1 is filled with the combustion gas, the thus produced hot combustion gas is circulated through the system.

As a temperature of the wood drying room 1 increases with the heat of the hot combustion gas, an oxygen content of an atmosphere in the room 1 decreases to lower a combustion speed of the fuel in the combustion chamber 21 of the combustion-gas generator 2, so that an increase rate in temperature of the wood drying room 1 is lowered.

Under such circumstances, the damper 61 of the exhaust-gas discharging conduit 6 is slightly opened to permit a part of the combustion gas (which is confined in the wood drying room 1) to escape to the chimney 7 through the exhaust-gas discharging conduit 6. As a result, a fresh air is introduced into the combustion chamber 21 of the combustion-gas generator 2 through the air-inlet conduit 4, an amount of which fresh air corresponds to that of the part of the combustion gas permitted to escape from the wood drying room 1. By controlling the amount of the fresh air introduced into the combustion chamber 21 of the combustion-gas generator 2, the combustion speed of the fuel in the chamber 21 is adequately controlled.

In addition, in operation, by operating both of the fans 51 and the dampers 52 of the combustion-gas recovery conduits 5, a part of the combustion gas confined in the wood drying room 1 is forcibly circulated through the system so as to be supplied to the combustion chamber 21 of the combustion-gas generator 2, so that the fresh air supplied to the combustion chamber 21 is diluted with the thus circulated part of the combustion gas to make it possible to keep the oxygen content of the atmosphere in the wood drying room 1 low. As a result, in the system, the oxygen content of the atmosphere in the wood drying room 1 is prevented from varying, and the room 1 is also even out or stabilized in temperature distribution.

As described above, in drying operation performed in the system of the present invention, the wood drying room 1 is filled with the hot combustion gas which is low in oxygen content and stabilized in temperature distribution. Consequently, it is possible to effectively dry the green woods in the wood drying room 1 of the system. The bulk of volatile gases produced from the green woods in the wood drying room 1 during drying operation is so circulated as to be sup-

plied to the combustion chamber 21 of the combustion-gas generator 2, in which chamber 21 these volatile gases are burned together with the fuel such as waste woods to produce a combustion gas. Consequently, it is possible for the wood drying system of the present invention to prevent the atmosphere from being contaminated by such volatile gases.

Incidentally, in the above embodiment of the system of the present invention, the exhaust-gas discharging conduit 6 is directly connected with the bottom corner portion of the of wood drying room 1. However, it is also possible for the system of the present invention to permit a part of the exhaust-gas discharging conduit 6 to form the combustion-gas recovery conduits 5.

Further, in the wood drying system of the present invention, it is also possible to form the exhaust-gas discharging conduit 6 as a branched conduit of any one of the combustion-gas recovery conduits 5.

Still further, in the wood drying system of the present invention, the gas flow-rate control unit is constructed of: the fans 51 and the dampers 52 combined with the fans 51; or the damper 41, 61 only. However, it is also possible to replace such gas flow-rate control unit with a speed-controllable fan capable of being controlled in rotational speed.

In wood drying system of the present invention, since the hot atmosphere in the wood drying room 1 is kept low in oxygen content while evened out or stabilized in temperature distribution, it is possible to produce the high-quality products or dried woods with good yields.

Claims

1. Method for drying wood comprising the following steps:
 - piling up green wood in a drying room;
 - closing the drying room so as to be hermetically sealed;
 - producing a hot combustion gas and introducing the gas into the drying room so as to gradually replace the air previously confined in the drying room until the room is filled with the combustion gas;
 - controlling the combustion speed in the combustion chamber by controlling the amount of fresh air introduced into the combustion chamber and by permitting an equivalent amount of the combustion gas to escape out of the room and by forcibly circulating a part of the combustion gas to keep the oxygen content of the atmosphere in the wood drying room at a stable low level and to stabilize the temperature distribution.
2. A system for carrying out the method according to claim 1, comprising:

a wood drying room (1) capable of being sealed;
 a combustion-gas generator (2) provided with an
 air-inlet conduit (4) for introducing a fresh air for
 combustion use into a combustion chamber (21)
 provided in a lower area of said combustion-gas
 generator (2);
 a combustion-gas supplying passage (3) extend-
 ing from an upper area of said combustion-gas
 generator (2) to an upper area of said wood dry-
 ing room (1);
 an exhaust-gas discharging conduit (6) extending
 from a bottom area of said wood drying room (1)
 to a chimney (7);
 a combustion-gas recovery conduit (5) extending
 from said bottom area of said wood drying room
 (1) to said combustion-gas generator (2); and
 a gas flow-rate control unit (41; 51; 52; 61) pro-
 vided in at least one of said exhaust-gas dis-
 charging conduit (6) and said combustion-gas re-
 covery conduit (5).

3. The system for drying woods according to claim 2, wherein: said combustion-gas recovery conduit (5) is directly connected with said combustion-gas generator (2).
4. The system for drying woods according to claim 2, wherein: said combustion-gas recovery conduit (5) is connected with said air-inlet conduit (4).
5. The system for drying woods according to claim 2, wherein: said gas flow-rate control unit, which is provided in at least one of said exhaust-gas discharging conduit (6) and said combustion-gas recovery conduit (5), is constructed of, in combination, a fan (51) and a damper (52).
6. The system for drying woods according to claim 2, wherein: said gas flow-rate control unit is constructed of at least one fan (51) and/or a damper (41; 52; 61).
7. The system for drying woods according to claim 6, wherein: said fan and/or said damper (41) is provided in said air-inlet conduit (4).
8. The system for drying woods according to claim 6, wherein: said fan (51) is provided in at least one of said air-inlet conduit (4), said exhaust-gas discharging conduit (6) and said combustion-gas recovery conduit (5).
9. The system for drying woods according to claim 2, wherein: said gas flow-rate control unit is constructed of a speed-controllable fan which is capable of being controlled in rotational speed.

Patentansprüche

1. Verfahren zum Trocknen von Holz, mit folgenden Schritten:
 Stapeln von rohem Holz in einem Trocknungsraum,
 Verschließen des Trocknungsraums derart, daß er hermetisch abgedichtet ist,
 Erzeugen eines heißen Verbrennungsgases und Einleiten des Gases in den Trocknungsraum derart, daß die ursprünglich in dem Trocknungsraum eingeschlossene Luft allmählich ersetzt wird, bis der Raum mit dem Verbrennungsgas gefüllt ist,
 Steuern der Verbrennungsgeschwindigkeit der Verbrennungskammer durch Steuern der Menge der Frischluft, die in die Verbrennungskammer eingeleitet wird, durch Entweichenlassen einer äquivalenten Menge des Verbrennungsgases aus dem Raum heraus, und durch zwangsweise im Kreislauf Führen eines Teils des Verbrennungsgases, um den Sauerstoffgehalt der Atmosphäre in dem Holz Trocknungsraum auf einem stabilen niedrigen Pegel zu halten, und um die Temperaturverteilung zu stabilisieren.
2. System zum Durchführen des Verfahrens gemäß Anspruch 1, mit:
 einem abdichtbaren Holz Trocknungsraum (1),
 einem Verbrennungsgasgenerator (2), der mit einer Lufteinlaßleitung (4) zum Einleiten von Frischluft zur Verbrennung in einer Verbrennungskammer (21) versehen ist, die in einem unteren Bereich des Verbrennungsgasgenerators (2) vorgesehen ist,
 einer Verbrennungsgaszufuhrpassage (3), die von einem oberen Bereich des Verbrennungsgasgenerators (2) zu einem oberen Bereich des Holz Trocknungsraums (1) verläuft,
 einer Abgasauslaßleitung (6), die von einem Bodenbereich des Holz Trocknungsraums (1) zu einem Kamin (7) verläuft,
 einer Verbrennungsgasrückgewinnungsleitung (5), die von dem Bodenbereich des Holz Trocknungsraums (1) zu dem Verbrennungsgasgenerator (2) verläuft, und
 einer Gasströmungsgeschwindigkeitssteuereinheit (41; 51; 52; 61), die in zumindest in der Abgasauslaßleitung (6) oder der Verbrennungsgasrückgewinnungsleitung (5) angeordnet ist.
3. System zum Trocknen von Holz gemäß Anspruch 2, wobei die Verbrennungsgasrückgewinnungsleitung (5) direkt an den Verbrennungsgasgenerator (2) angeschlossen ist.
4. System zum Trocknen von Holz gemäß Anspruch 2, wobei die Verbrennungsgasrückgewinnungsleitung (5) an die Lufteinlaßleitung (4) ange-

schlossen ist.

5. System zum Trocknen von Holz gemäß Anspruch 2, wobei die Gasströmungsgeschwindigkeitssteuereinheit, die zumindest in der Abgasauslaßleitung (6) oder der Verbrennungsgasrückgewinnungsleitung (5) vorgesehen ist, in Kombination aus einem Gebläse (51) und einem Schieber (52) besteht.
6. System zum Trocknen von Holz gemäß Anspruch 2, wobei die Gasströmungsgeschwindigkeitssteuereinheit zumindest aus dem Gebläse (51) und/oder einem Schieber (41; 52; 61) besteht.
7. System zum Trocknen von Holz gemäß Anspruch 6, wobei das Gebläse und/oder der Schieber (41) in der Lufteinlaßleitung (4) vorgesehen ist.
8. System zum Trocknen von Holz gemäß Anspruch 6, wobei das Gebläse (51) zumindest in der Lufteinlaßleitung (4), der Abgasauslaßleitung (6) oder der Verbrennungsgasrückgewinnungsleitung (5) vorgesehen ist.
9. System zum Trocknen von Holz gemäß Anspruch 2, wobei die Gasströmungsgeschwindigkeitssteuereinheit aus einem Geschwindigkeitssteuerbaren Gebläse aufgebaut ist, dessen Drehzahl steuerbar ist.

Revendications

1. Procédé de séchage de bois comprenant les étapes suivantes :
empilage du bois vert dans une chambre de séchage ;
fermeture de la chambre de séchage de façon à obtenir une fermeture hermétique ;
production d'un gaz de combustion chaud et introduction du gaz dans la chambre de séchage de façon à remplacer progressivement l'air confiné auparavant dans la chambre de séchage jusqu'à ce que la chambre soit remplie de gaz de combustion ;
réglage de la vitesse de combustion dans la chambre de combustion par réglage de la quantité d'air frais introduite dans la chambre de combustion et en permettant à une quantité équivalente de gaz de combustion de s'échapper de la chambre et en faisant circuler à force une partie du gaz de combustion pour maintenir la teneur en oxygène de l'atmosphère dans la chambre de séchage du bois à un faible niveau stable et pour stabiliser la répartition de la température.
2. Système pour la mise en oeuvre du procédé se-

lon la revendication 1, comprenant :

une chambre (1) de séchage du bois susceptible d'être fermée hermétiquement ;
un générateur (2) de gaz de combustion muni d'une conduite (4) d'alimentation en air pour introduire de l'air frais pour l'utiliser dans la combustion dans une chambre de combustion (21) disposée dans une zone inférieure dudit générateur (2) de gaz de combustion ;
un passage (3) d'alimentation de gaz de combustion s'étendant d'une zone supérieure dudit générateur (2) de gaz de combustion vers une zone supérieure de ladite chambre (1) de séchage du bois ;
une conduite (6) de décharge de gaz d'échappement s'étendant d'une zone de fond de ladite chambre (1) de séchage du bois vers une cheminée (7) ;
une conduite (5) de récupération de gaz de combustion s'étendant de ladite zone de fond de ladite chambre (1) de séchage du bois vers ledit générateur (2) de gaz de combustion ; et
une unité (41 ; 51, 52 ; 61) de réglage du débit de gaz disposée dans au moins une de ladite conduite (6) de décharge de gaz d'échappement et de ladite conduite (5) de récupération de gaz de combustion.

3. Système pour le séchage des bois selon la revendication 2, dans lequel ladite conduite (5) de récupération de gaz de combustion est reliée directement audit générateur (2) de gaz de combustion.

4. Système pour le séchage des bois selon la revendication 2, dans lequel : ladite conduite (5) de récupération de gaz de combustion est reliée à ladite conduite (4) d'alimentation en air.

5. Système pour le séchage des bois selon la revendication 2, dans lequel : ladite unité de réglage du débit de gaz, qui est disposée dans au moins une de ladite conduite (6) de décharge de gaz d'échappement et de ladite conduite (5) de récupération de gaz de combustion, est constituée, en combinaison, d'un ventilateur (51) et d'un clapet (52).

6. Système pour le séchage des bois selon la revendication 2, dans lequel : ladite unité de réglage du débit de gaz est constituée d'au moins un ventilateur (51) et/ou d'un clapet (41 ; 52 ; 61).

7. Système pour le séchage des bois selon la revendication 6, dans lequel : ledit ventilateur et/ou ledit clapet (41) est disposé dans ladite conduite (4) d'alimentation en air.

8. Système pour le séchage des bois selon la revendication 6, dans lequel : ledit ventilateur (51) est disposé dans au moins l'une de ladite conduite (4) d'alimentation en air, de ladite conduite (6) de décharge de gaz d'échappement et de ladite conduite (5) de récupération de gaz de combustion.

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9. Système pour le séchage des bois selon la revendication 2, dans lequel : ladite unité de réglage du débit de gaz est constituée par un ventilateur à vitesse réglable dont on peut régler la vitesse de rotation.

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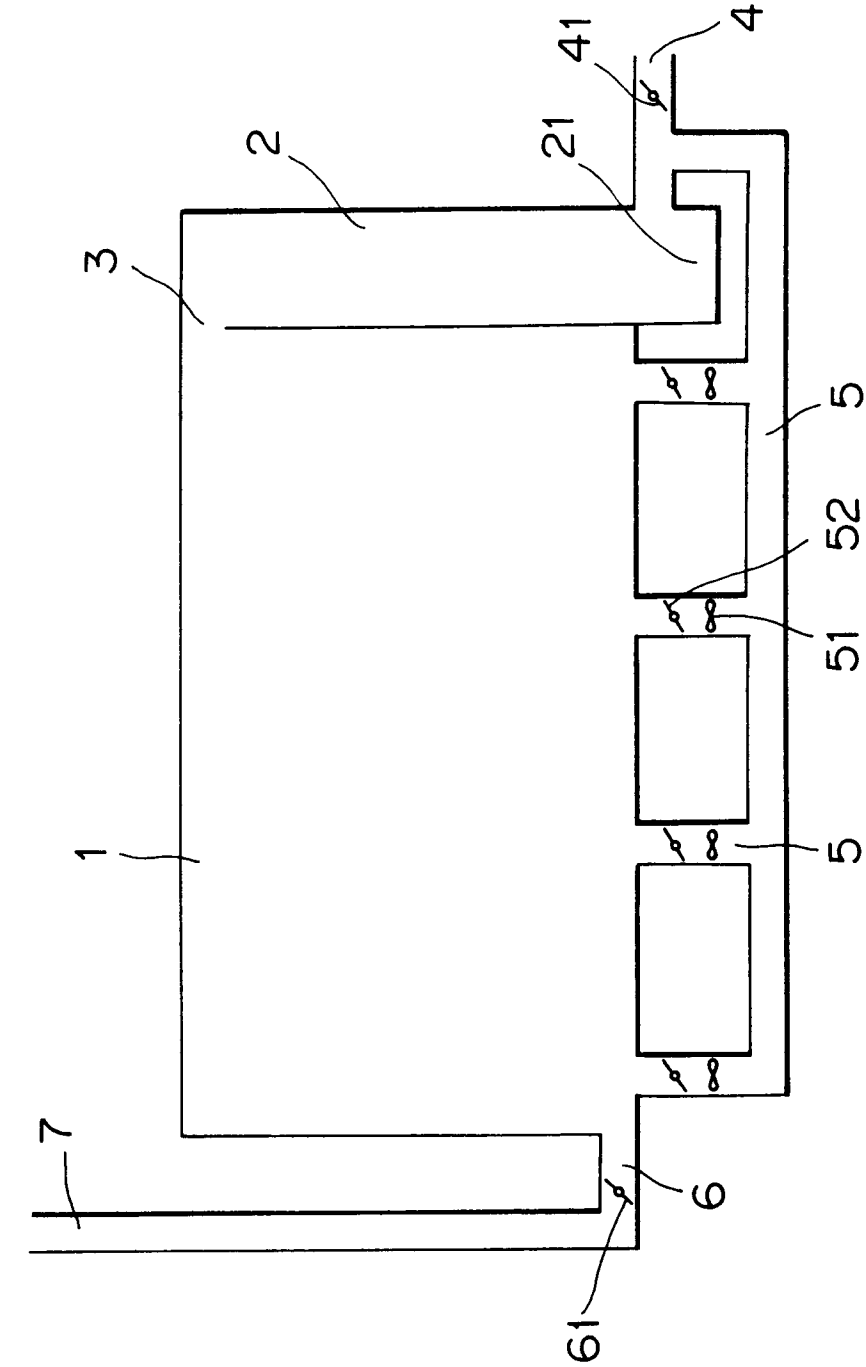
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Figur 1